

Sanford Medical Center's

**Aunt Cathy's
Guide to Nutrition:

MAGNESIUM**



Aunt Cathy

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Short Version with Minimal References Included

Usual Recommended Intake for Healthy People:

RDA: Adult women 320; men 420mg
 Pregnancy 350-400 mg
 Lactation 320-360 mg

- 1) This mineral plays a role in over 300 functions in the body, including energy production, all protein metabolism, nervous system activity, and bone flexibility.
- 2) Most American adults take in less than 2/3 of the RDA. Large national studies (such as NHANES by the National Center for Disease Control in Atlanta) have shown that the majority of Americans have a diet too low in these minerals. This inadequacy contributes to weight problems, diabetes, heart disease and some neurologic problems that are too common in our society.
- 3) Intake of magnesium is hard to estimate except for asking some key questions about a person's diet. The actual intake of this mineral cannot be evaluated any other way.
 - The blood magnesium level can be measured, but it does not necessarily reflect adequacy of magnesium intake or determine if there is an adequate amount in the cells of the body. Usually it just indicates that a person's kidneys are on the job, since the blood Mg level is regulated by the kidney.
 - Estimates are that as many as a third of hospitalized patients have a low magnesium level in their blood that can complicate their care. Poor magnesium status upon entering a hospital is a predictor of a less favorable outcome. So, if one's blood level is low, it may reflect inadequate intake, but it also may be due to excessive losses or a number of other metabolic disturbances (and so a low blood magnesium level is a very important laboratory finding.)

- However, a normal blood magnesium level tells us very little about the adequacy of magnesium inside the body's cells, where most of the magnesium-dependent work is trying to be done. Therefore, the best way to know if people's intake of magnesium is appropriate is to obtain a careful history of their usual intake from foods and supplements.
- At present a magnesium intake evaluation is rarely done because of lack of time, lack of information about what are the key magnesium-containing foods to ask about, and/or a lack of awareness that a person's magnesium intake may easily be poor and also contributory to poor health outcomes.
- Low magnesium intake is associated with a number of adverse health conditions. However, as is the case for most minerals, excessive intake from high-dose supplements is not safe. In most cases, supplemental magnesium in the neighborhood of the RDA levels is certainly safe even when taken along with a diet that provides a generous amount. An important exception to this rule are people with kidney problems that impair the ability control blood magnesium level.

A Brief Overview of Associations of Poor Magnesium Status with Adverse Health Conditions:

Diabetes:

High blood sugar contributes to **magnesium loss** in the urine and at the same time poor magnesium status can **increase insulin resistance** because magnesium is required by the insulin receptors on the cells. Low magnesium intake may also contribute to the **development** of diabetes, heart disease and stroke, and to certain complications of diabetes such as retinopathy and neuropathy. Many studies have shown that people with diabetes often have poor magnesium status. Improved blood sugar control is associated with eating a "high fiber diet," which also provides a better intake of magnesium and chromium, both of which play very important roles in blood sugar and lipid metabolism.

For example, recently researchers at Harvard University published the results of a prospective study of almost 84,000 women who were followed for 16 years. It was found **that those who ate nuts or peanut butter four times a week or more had 25% less likelihood of developing Type II diabetes** (the adult type) than was found for women who ate these foods rarely or never. Nuts and peanut butter are especially rich in magnesium, chromium, vitamin E, monounsaturated fat and omega-3 polyunsaturated fats. All of these nutrients have the potential to have played a protective role in this study. Later the data was analyzed differently, it was found that **the same pattern existed when the highest and lowest magnesium intake groups were compared.** Magnesium

inadequacy also is being implicated as a contributor to the development of Type II diabetes in young people that is evolving from the epidemic of childhood obesity .

Cardiovascular Disease and Hypertension:

Abnormal magnesium status is common in patients with cardiovascular diseases for a number of reasons, including poor dietary intake or excessive losses due to use of diuretics or diabetes. Dietary magnesium inadequacy is an independent risk factor in predicting the development of hypertension and cardiovascular disease. Some of the benefits of high fiber diets, legumes (especially peanuts) and nut consumption in decreasing cardiovascular risk are likely due in part to the magnesium content.

Osteoporosis and Bone Health:

Healthy bone production relies on the implantation of calcium into a flexible core called the bone “matrix.” Magnesium is crucial for the development of the bone matrix, and so **inadequacy can increase the fragility of bone** (because it is less flexible) and it can impair recovery from bone injury.

It is also important to note that calcium and magnesium also interact in other areas of the body, such as nervous system function, blood pressure control and blood clotting, so maintaining an appropriate ratio is extremely important. For example, there is concern that excessively generous calcium supplementation without attention to the calcium: magnesium ratio may increase risk of thrombosis and stroke. With so much calcium fortification and supplementation taking place, we cannot afford to ignore the fact that many Americans have a poor magnesium intake and/or high magnesium losses.

Pregnancy:

Some researchers feel that prenatal magnesium adequacy has a higher priority than even iron supplementation because of the over 300 enzyme systems in the body that depend on magnesium to function properly. Several measures of pregnancy outcome, such as **higher frequency of spontaneous abortions (miscarriage), fetal growth retardation, birth defects, maternal hospitalizations, preterm delivery, SIDS and referrals to NICUs** have been found to be associated with poor magnesium status in pregnancy. [These issues are related to general nutrition and are separate from issues related to the acute therapeutic i.v. magnesium sometimes used in the treatment of pre-eclampsia or premature labor.]

Other studies have shown a benefit of assuring magnesium adequacy (i.e. providing the RDA level of magnesium) in the reduction of **leg cramps** in pregnancy. **Pregnant women with diabetes** need special attention to adequacy of magnesium intake because of the potential for increased losses and the common finding of poor magnesium status among people with diabetes in particular. In addition, inadequacy of magnesium is a risk factor for the **development of gestational diabetes** as well as Type II diabetes.

Migraine Headaches:

For some migraine sufferers, **assuring adequacy** of magnesium intake resolves migraine problems. For others, it decreases the frequency or intensity of the headaches. So, while Mg status is certainly not the only factor involved in the development of migraines, this intervention can be helpful, and it is safe and inexpensive, so many experts in headache treatment regard assuring magnesium adequacy as a primary intervention.

Premenstrual Syndrome (PMS):

Providing magnesium at the RDA level has been shown to improve “affect” (mood or emotional well-being), and certain tissues of women suffering from PMS have been shown to be low in magnesium. Brain levels of the neurotransmitter serotonin appear to be significantly involved in PMS, and medications that adjust serotonin levels are now being used. Assuring adequacy of magnesium may be a factor (both with and without other medication) because it also is required for the production and metabolism of serotonin (and all neurotransmitter metabolism.) In any case, assuring adequacy of magnesium can only help, and inadequacy could potentially contribute to problems.

Cancer:

In 2005 a population-based prospective study of 61,433 women suggested that a high magnesium intake may reduce the occurrence of **colorectal cancer**. Animal studies have also suggested that a higher dietary intake of magnesium is associated with decreased risk of colon cancer, possibly related to an effect of the magnesium-containing substance called chlorophyll protecting against cancer-promoting properties of a structurally similar substance in red meat called heme (or “haem” in the UK.) In addition, in 2004 it was reported that a lower magnesium level in drinking water was associated with risk of death from **ovarian cancer**.

Kidneys, stone forming, and other renal issues:

Low magnesium intake has a role in the development of kidney stones, and the kidney has an important role in regulating magnesium in the blood.

Miscellaneous:

Magnesium adequacy has been found to be a factor in the development and/or management of many chronic conditions, such as **asthma**, certain **thyroid** conditions, **alcoholism**, **pancreatitis**, **hearing loss**, and possibly **Tourette’s Syndrome**, **Raynaud's phenomenon**, **pain management**, corneal disease, skin problems, attempts to quit **smoking**, and certain **hyperexcitable states**.

Magnesium Losses and Safety Issues:

Conditions like **chronic diarrhea, high blood sugar, or the regular use of certain drugs** (such as thiazide diuretics) cause magnesium loss. As a rule, drugs for which patients are advised to eat a high potassium diet or to take potassium supplements are also likely to cause loss of magnesium. This problem is often unrecognized, however, and because of an interaction between magnesium and potassium, the failure to correct magnesium losses along with potassium losses further compromises the body's ability to achieve normal potassium status in the cells.

As is the case with potassium, **most vitamin/mineral supplements contain little magnesium or none at all**. And also like potassium, there may be **a need to take in less when one has certain kidney problems**.

As noted above, excessive intake from supplements or magnesium-containing medications can also cause problems, so never give nutritional supplements of magnesium above the level described in the RDA table above unless prescribed by a doctor. It is also useful to know that magnesium oxide, chloride and diglycinate are the kinds of magnesium that are usually used as a supplement . . . magnesium sulfate (Epsom salts) and hydroxide ("milk of magnesia") are less well absorbed and more likely to cause diarrhea instead (which is why they are used to treat constipation . . . in fact, magnesium citrate is often used as a pre-coloscopy bowel-cleaning product!) There are a number of magnesium-containing medications, like some over-the-counter antacid products. Check with a pharmacist about magnesium in specific products.

Finding Good Food Sources of Magnesium:

- 1. When you eat grain products, try to use whole grain whenever possible.**

The "germ" (the part that becomes the baby plant) and the bran (the fibrous coating) of grains are removed in processing when grains are "refined." After removing the germ and bran, four of the nutrients that were lost are added back: vitamins B1, B2, B3 and iron, and the grain product is called "enriched." That sounds pretty good, but they do not replace the parts that would have contributed the most magnesium, chromium, vitamin E, fiber and many other nutrients. Magnesium and chromium have important roles in using the rest of the grain (the starchy part) for energy and for avoiding diabetes. **So, when you see the term "enriched" think of it as "UNriched" ... because it is actually missing many important nutrients that the germ and bran would have contributed.**

However, if one really doesn't like whole grain bread or other whole grain products, many of these missing nutrients can be found in nuts and legumes and other foods described below. For example, putting peanut butter on the bread helps fill the nutrition gap associated with eating only "enriched" grain products. Also, it is not necessary that these foods be eaten at the same time ... we just need to identify some good magnesium sources that a person likes and include them regularly.

2. Nuts, seeds, peanuts and dried beans/peas are terrific nutrient-rich foods because they are essentially the germ of new plants ... the "baby plant."

For example, in one study from Harvard, eating an ounce of nuts or peanuts four times a week or more was shown to be related to 25% less likelihood of developing diabetes. This appears to be associated with the generous magnesium in these foods. They also have more "satiety value" – you feel like you actually ATE something" -- and they are terrific nutritious snacks including for people who are watching their weight or who have diabetes.

[Some references: Regular consumption of nuts is associated with a lower risk of cardiovascular disease in women with type 2 diabetes. J Nutr. 2009 Jul;139(7):1333-8. Prospective study of nut consumption, long-term weight change, and obesity risk in women. Am J Clin Nutr. 2009 Jun;89(6):1913-9. Nuts and health outcomes: new epidemiologic evidence. Am J Clin Nutr. 2009 May;89(5):1643S-1648S. The role of tree nuts and peanuts in the prevention of coronary heart disease: multiple potential mechanisms. J Nutr. 2008 Sep;138(9):1746S-1751S.]

Although all fats have about 9 calories per gram, the forms of fat in nuts and Peanuts (mostly "monounsaturated" and "omega-3" fats) are less contributory to heart disease than many other forms of fat. Also they are rich in nutrient content so they are not an "empty calorie" food. So, although they do have calories, I think of these forms of fat as potentially "Dangerous to your butt, but not to your heart!" Additionally, dried beans and peas are also very low in fat and high in fiber. It looks like that means chili beans, lima beans, split peas, chick peas, navy beans, lentils, pinto beans, etc., are "health foods!"

These foods, and assuring adequacy of magnesium (and chromium, another key mineral in the same foods) in general, are especially beneficial for people who appear to be genetically (or for whatever reason) at greater risk of developing diabetes. This includes people who have family members with diabetes, people who are overweight, and some ethnic groups who appear to be disproportionately at risk.

For example, serious health problems related to diabetes have been found to be causing much more injury to Native Americans and African Americans than to some other groups of folks. There are many contributing factors, of course, but assuring adequacy of magnesium and chromium (another key mineral in the same foods) is one factor that can be easily corrected if people just hear about it. [Vitamin D is another, as discussed in my other papers.]

Food sources are the **best way to safely assure adequacy**, with the added benefit of the other nutrients they provide and the pleasure derived from eating them. Unlike supplement sources, dietary sources of magnesium do not contribute to diarrhea, and there is not a concern about potential overdose. Only people with renal failure or another serious medical conditions may be advised by a physician to limit intake of dietary magnesium.

As can be seen below, the best sources of magnesium are also foods recommended as healthy choices by the American Dietetic Association, and by many professional health associations concerned with cardiovascular health, diabetes and cancer. And although the nuts and peanut butter do contribute fat and calories, they can easily be included as a part of a healthy diet when used in place of other high calorie or high fat foods.

As an added bonus, the form of fat in these foods is rich in monounsaturated fat and omega-3 fatty acids. They are low in saturated fat and trans fatty acids, have no cholesterol, and compared with other forms of fat, they are generally found to be protective against heart disease, diabetes and cancer.

Some of the Best Dietary Sources of Magnesium:

Magnesium (mg per 1/2 cup)

500 mg or more	Peanuts and Peanut butter
100-300mg	Wheat germ*, Bran cereals*, Wild rice Lentils, Split peas, Tofu, Cashews, Almonds
25-90 mg	Fortified breakfast cereals, Oatmeal, Miso, Spinach, Milk, Yogurt, Fish, Brewer's yeast (80 mg/Tblsp), Cocoa powder (25 mg/Tblsp)

*Note that refining grains removes most of the magnesium and it is **not** added back as iron is when grain is "enriched." The phytate content of the grain is also a factor in the availability of dietary magnesium.

A few more references: [Effects of the regular consumption of wholemeal wheat foods on cardiovascular risk factors in healthy people. Nutr Metab Cardiovasc Dis. 2009 Jun 5. Am J Epidemiol. 2009 Jun 15;169(12):1437-44. Dietary calcium and magnesium intakes and the risk of type 2 diabetes: the Shanghai Women's Health Study. Am J Clin Nutr. 2009 Apr;89(4):1059-67. Serum and dietary magnesium and risk of ischemic stroke: the Atherosclerosis Risk in Communities Study. Am J Epidemiol. 2009 Jun 15;169(12):1437-44. The efficacy and safety of oral magnesium supplementation in the treatment of depression in the elderly with type 2 diabetes: a randomized, equivalent trial. Magnes Res. 2008 Dec;21(4):218-23. Dietary intake of selected minerals for the United States population: 1999-2000. Adv Data. 2004 Apr 27;(341):1-5. Diabetes mellitus and magnesium. Clin Calcium. 2005 Feb;15(2):203-12. Magnesium and hypertension. Clin Calcium. 2005 Feb;15(2):255-60. Magnesium in congestive heart failure. Clin Calcium. 2005 Feb;15(2):181-6]